Minutes of the Open Meeting on March 7-8, 2011

U.S. Environmental Protection Agency (EPA)
Science Advisory Board (SAB)
Panel for the Review of Hydraulic Fracturing Study Plan

Summary Minutes of the Advisory on EPA's draft Hydraulic Fracturing Study Plan

Date and Time: Monday March 7, 2011, 9:00 A.M. – 5:30 P.M.; Tuesday, March 8, 2011, 8:00 A.M. – 5:00 P.M.

Location: Westin Alexandria Hotel located at 400 Courthouse Square, Alexandria, VA, 22314

Purpose: The purpose of the meeting was to review and provide advice on the scientific adequacy and appropriateness of EPA's Draft Hydraulic Fracturing (HF) Study Plan that will assess the potential impacts of HF on drinking water resources.

Participants:

SAB Panel: Panel for the Review of draft Hydraulic Fracturing Study Plan (See Roster, Attachment A)

Dr. David A. Dzombak, Chair
Dr. George Alexeeff
Dr Tom Ballestero
Dr. Mark Benjamin
Dr. Michel Boufadel
Dr. Elizabeth Boyer
Mr. David Burnett
Dr. Thomas L. Davis
Dr. Shari Dunn-Norman
Dr. John P. Giesy
Dr. Jeffrey Griffiths
Dr. Phillip Gschwend
Dr. Cynthia M. Harris
Dr. Nancy K. Kim
Dr. Cindy M. Lee
Dr. Duncan Patten
Dr. Stephen Randtke
Dr. Danny Reible
Dr. Connie Schreppel
Dr. Geoffery Thyne
Dr. Jeanne VanBriesen
Dr. Radisav Vidic

Mr. David Burnett could not participate at meeting, but provided comments

EPA SAB Staff:	Mr. Edward Hanlon, Designated Federal Officer Dr. Anthony Maciorowski, Deputy Director, EPA Science Advisory Board Staff Office Dr. Vanessa Vu, Director, EPA Science Advisory Board Staff Office
EPA Presenters:	Dr. Kevin Teichman, EPA Office of Research and Development (ORD) Ms. Jeanne Briskin, EPA ORD Dr. Robert Puls, EPA ORD
Other Participants:	Steve Kraemer, EPA ORD (via telephone) Jim Weaver, EPA ORD (via telephone)
Other Attendees:	See Attachment B, Public Attendance.

Materials Available: The agenda, roster, and meeting materials were circulated to the Panel in advance of the meeting. These materials were made available to the public via the SAB Web site (www.epa.gov/sab) and hard copies were also provided and made available to the public for review at the meeting. The meeting materials are available on the following SAB HF March 7-8, 2011 meeting websites:
http://yosemite.epa.gov/sab/sabproduct.nsf/a84bfee16cc358ad85256ccd006b0b4b/153ac7df8d2626f98525781000648075!OpenDocument&Date=2011-03-07
and
http://yosemite.epa.gov/sab/sabproduct.nsf/a84bfee16cc358ad85256ccd006b0b4b/153ac7df8d2626f98525781000648075!OpenDocument&Date=2011-03-08.

Meeting Summary

The meeting was announced in the Federal Register[1] and proceeded according to the meeting agenda[2]. A summary of the meeting follows.

March 7, 2011

Opening Statements and Welcome

Mr. Ed Hanlon, the Designated Federal Officer (DFO), opened the meeting, and made a brief opening statement noting that the HF Study Plan Review Panel is a Federal Advisory Committee under the Federal Advisory Committee Act (FACA). He noted the meeting was open to the public and that thirteen of fourteen organizations listed in the list of public speakers[3] would present oral statements at the meeting. He stated that Craig Segall of the Sierra Club would not present an oral statement at the meeting, even though he was listed as a public speaker. Mr. Hanlon also noted minutes of the meeting were being taken to summarize discussions and action items in accordance with requirements under FACA. Drs. Anthony Maciorowski and Vanessa Vu, Deputy Director and Director of the SAB Staff Office, respectively, also welcomed everyone for their attendance.

The meeting was turned over to the Chair, Dr. David Dzombak. Dr. Dzombak noted this is an Advisory effort where a report seeking consensus would be prepared. Dr. Dzombak noted preliminary Panel member comments were provided in Panel member folders and on the meeting website, and that the preliminary comments were intended to serve as 'discussion starters'. He also noted that public comments submitted directly to Ed Hanlon are provided on the meeting website. Dr. Dzombak reviewed the agenda and requested that Panel members introduce themselves.

Dr. Kevin Teichman of EPA's Office of Research and Development (ORD) made a brief opening statement and opened with presenting and discussing the first seven EPA ORD Powerpoint slides[4] that were projected onto the meeting screen and provided on the meeting website. Ms. Jeanne Briskin then followed Dr. Teichman and presented ORD's slide numbers 8 through 21, and Dr. Puls then followed Ms. Briskin with presenting ORD's slide numbers 22 through 29.

Several Panel members asked about future activities and deliverables. Dr. Puls noted that EPA planned to prepare a report in 2012 and also in 2014. These reports would summarize the retrospective and prospective case study efforts and other EPA activities associated with HF research. He noted that EPA would be seeking involvement and input from a wide group of stakeholders. He also noted there is large variability across the United States regarding HF operations, including variability in formation type, geographic locations, population (rural, urban, suburban), wastewater treatment, Underground Injection Control (UIC) methods, and treatment operations.

Dr. Puls also noted that a goal is to get the public involved up front in planning the prospective and retrospective studies. Ms. Briskin noted that EPA intended to publish research results broadly and let public know immediately if significant environmental concerns are identified through the research. She noted that EPA would publish research after peer review occurred on the 2012 and 2014 EPA HF reports.

Several Panel members asked questions on how HF modeling would occur and under what scenarios. Dr. Puls noted that EPA would assess various failure scenarios over extended time periods, and also that EPA would assess well integrity and sources for impacts associated with HF wells through various efforts including modeling and monitoring. He mentioned that EPA would hydrogeologically assess fracturing pathways and underground sources of drinking water, particularly in areas where a potential link between fracture zones and drinking water were suspected.

Several Panel members asked questions on environmental justice concerns associated with EPA's HF research, and Ms. Briskin noted that the public raised a number of Environmental Justice concerns regarding EPA's HF research plans. She noted that such concerns would be considered as part of EPA's HF research.

Public Comment

Mr. Gary Slagel, Marcellus Shale Coalition, provided an oral statement. Mr. Slagel noted that many concerns that the Marcellus Coalition is raising are being raised by EPA in its draft HF Study Plan or are being raised by the Panel. He noted that the Coalition was founded in 2008 to assess development in the shale, and comprises a number of states. The Coalition tries to ensure that development of this energy source occurs in an environmentally friendly manner. He noted

that the scope of EPA's study exceeds the goals of the Congressional intent of the study, and that:

1) Plan assesses more than intended by Congress.
2) Role of state regulators is not assessed in the EPA study plan.
3) The influence of state regulations is not adequately considered in the EPA study plan.
4) The Coalition supports use of retrospective and prospective case studies, but the relevance of particular sites must be fully considered.
5) Analysis is needed on risk assessment.
6) Some of the references upon which the EPA study plan is based are not from peer reviewed literature.

Mr. Tim Stewart of Western Energy Alliance provided an oral statement. He noted Western Energy Alliance represents over 100 companies, and requested that the Panel review their written comments. He noted that EPA's project is too broad and goes beyond Congressional intent. He noted that EPA's conceptual model was not covering a number of key issues, such as well integrity. He further stated that EPA should focus on risk to drinking water and should include cost/benefit analysis.

Ms. Susan Oliver provided an oral statement.[5] She and her husband own land in the Marcellus area in New York State. She noted that New York City (NYC) should be concerned about threats of contaminants, but HF is not a primary threat and is being used as a scapegoat for other problems. She expressed the view that Marcellus Shale gas presents a tremendous opportunity for New York and the nation. She stated that EPA is a critical partner who should separate truths from fears and not get bogged down with unfounded fears. She requested that EPA focus on bringing forward the best science in its HF study, and engage colleges and universities in this effort. She also stated that industry should step up to make sure that the gas development is conducted in a responsible manner.

Mr. Dennis Degner of Range Resources - Appalachia, LLC provided an oral statement. He noted HF is critical resource, and that horizontal drilling can recover a vast amount of natural gas. He stated that HF has been performed safely for more than 60 years, and to review his company's website for information on safely drilling horizontal wells. He noted that although fracturing occurs one mile below surface, wells are multiple cased and protect drinking water supplies. He urged EPA to take a scientific approach, work with industry when conducting case studies, and utilize EPA's 2004 study results.

Ms. Cynthia Lane of American Water Works Association (AWWA) provided an oral statement.[6] She noted AWWA is an international, nonprofit organization that is dedicated to drinking water supply. She stated that the Monongahela River has been sampled and indicates contamination including brominated byproducts used in the HF process. She also stated that several utilities are in violation of Stage 1 Disinfection requirements and this occurred after HF started in the area. She requested that ORD's case studies include this occurrence, and that Section 6.5 of ORD's study – impacts of discharges on drinking water supplies – should be expanded to include more examination of specific cases involving western Pennsylvania drinking water suppliers and effects of HF contamination.

Mr. Craig Segall of Sierra Club Environmental Law Program had requested to provide an oral statement, but was not present at the meeting and did not provide a statement.

Ms. Sarah Gingold of Food and Water Watch provided an oral statement.[7] She noted that Food and Water Watch is a nonprofit organization that advocates for common sense policies for safe food and water. She commended SAB and EPA for taking this study on, and requested that EPA use its authority for onsite data collection and reporting on this topic. She was concerned that the draft HF Study Plan does not assess human health issues regarding wastewater treatment. She stated that if toxic substances including radioactive and other materials are not removed from wastewater, the water goes into surface waters that are used for downstream drinking water supplies. She stated that sewage treatment plants cannot remove these constituents efficiently. She requested that EPA expand the study plan to examine treatment challenges more closely.

Ms. Amy E. McDonnell of Chesapeake Bay Foundation, Inc. (CBF) provided an oral statement. She stated that CBF encourages EPA to take a broader perspective to encompass overall ecosystem health, which governs the quality of water resources. She also encouraged more investigation of human health impacts associated with HF. She noted that NOx, Sox, VOC's, methane, and other contamination from traffic, exhaust and other releases cause air quality problems. She also noted that while EPA adopted a Total Maximum Daily Load (TMDL) for Chesapeake Bay in December 2010, the TMDL does not take into account HF fluid quantities. She stated that wastewater sewage plants cannot handle the HF wastewater.

Ms. Lauren Pagel of EARTHWORKS provided an oral statement.[8] She noted that water contamination is possible in any stage of the HF process, from transport of chemicals to the production of fluids. She stated that a full lifecycle analysis should assess potential threats, including those from radioactive contaminants. She noted that work with communities has shown that the lack of a regulatory structure to regulate HF is a significant issue. She stated that EPA's draft HF Study Plan should assess well casings, since repeated pressure treatments to well casings are not well understood. She recommended the Wattenberg field in Colorado as a potential case study site, as it has a mix of older and newer, horizontally drilled wells. She cautioned the SAB Panel and EPA to not rely solely on natural barriers in rock and active barriers for preventing fluid transport, and stated that it is difficult to predict the length and width of fractures. She noted that fractures can extend up to 3000 feet beyond where the fractures were expected to go. She supported retrospective and prospective case studies, and noted that retrospective study modeling should assess predicted vs. actual fracture length.

Ms. Briana Mordick of the Natural Resources Defense Council provided an oral statement.[9] She strongly commended EPA on its efforts to assess impacts to drinking water. She noted that there were a number of instances where HF has affected drinking water, and that while many citizens have reported problems, investigation of such problems did not occur. She noted that several topics that EPA plans to exclude from assessment should be included in the study, specifically, seismic impacts and impacts to terrestrial species. She recommended that cumulative impacts over the lifetime of a HF project be included within EPA's study, and that best management practices (BMPs) for each stage of HF practice should be assessed. She also recommended that EPA particularly consider wellbore integrity over time in old HF wells and such well's potential impacts to drinking water. She requested that EPA include various stakeholders in the HF study, and recommended that EPA conduct unannounced inspections at operating HF facilities. She encouraged EPA to assess potential risks and impacts to air, land, wildlife, and community character. She recommended that a full HF lifecycle be assessed, and be unbiased, peer reviewed, and free of political pressure.

Mr. Lynn Howard Ehrle who is Chair of the International Science Oversight Board provided an oral statement via the teleconference line. He noted that there is no representation of

environmental groups on the SAB panel, and stated that the SAB process is not satisfactory for stakeholder engagement. He noted that the SAB Panel took a half hour of public comment time, and asked that he be provided ten minutes to cover process questions that would not be addressed. He stated that industry has unlimited resources, and that the mantra of industry is that any identified problem "is being studied." He stated that he has studied public policies and radiation and health effects at low doses for 40 years, and that radiation is a key issue for HF operations. He recommended that an independent radiological panel be formed to assess these issues, and requested that stakeholders have far greater representation in EPA's assessment of HF issues.

Mr. Jeff Zimmerman of the Damascus Citizens for Sustainability and Friends of the Upper Delaware River provided an oral statement. He noted that the Delaware River is used by 20 million people, and that New York City draws 35% and Philadelphia 50% of their drinking water from the river. He noted that certain contaminants in HF wastewater may pass through treatment plants without treatment and may not be covered in National Pollutant Discharge Elimination System (NPDES) permits (e.g., radionuclides, biocides, chlorides, nano particles, Total Dissolved Solids (TDS), and other contaminants). He recommended that EPA's case studies investigate environmental conditions for more than one year, since it often takes about a year to see HF contaminants in drinking water (e.g., methane and benzene, toluene, ethylbenzene, and xylenes (BTEX). He commended EPA's plans to use tracers for the prospective studies, and noted tracers should be standard HF industry practice to identify sources of contaminants, particularly when widely spaced wells are used. He encouraged EPA to include wells in case studies that have conducted HF more than once, and to reach out to grass-root organizations.

Dr. Deborah Cowden provided an oral statement.[10] She noted she was a board-certified health professional, and expressed concern that most health studies have assessed only one contaminant at a time, whereas with HF operations there is potential for exposure of people to multiple chemicals simultaneously. She noted she is seeing evidence of diarrhea, fainting, and other symptoms in her office, and noted that HF chemicals are a risk management nightmare from a medical perspective. She stated that preliminary studies used by industry indicate that HF is safe but that more information is needed to assess the risks. She suggested that Material Safety Data Sheets be provided to HF workers that indicate all chemicals used in the HF process.

Dr. Dzombak asked if Mr. Seagal was present from Sierra Club three times during the meeting. Mr. Seagal did not arrive to present his comments.

Charge Question 1: Water Use in Hydraulic Fracturing

The Panel members noted that EPA's use of the water lifecycle shown in Figure 7 of the draft HF Study Plan to characterize hydraulic fracturing and to identify the potential drinking water issues should take a broader view regarding water quantity issues. It was noted that the broader view should focus on linking HF lifecycle issues with the natural hydrological cycle. The Panel suggested that one way to do this is to put a box around the block diagram in Figure 7 that provides a linkage to the hydrological cycle and to a water acquisition block. The Panel also recommended changing wording from 'impact of water withdrawal on water quality' to 'impact on environmental flows and water quality'. Members noted that it is important to consider water mass balance for any particular HF site or collection of sites, and that EPA's use of case studies is probably the best way to carry this out rather than handling this generically. The Panel noted that a critical issue of water balance analysis is the change in the natural hydrologic

(environmental) flows. The Panel stated that HF operations remove and store a large water volume and recommended that this water be tied into the broad hydrological cycle. The Panel also suggested that the first line of Figure 7 be changed to water availability and environmental flows.

Charge Question 2: Research Questions

The members recommended that EPA identify best practices and widely used practices in use in all aspects of HF operations. The Panel suggested that EPA consider potential Environmental Justice impacts in HF processes. Several members commented on the growing practice of recycling and reuse of water and flowback water in HF operations, and stated that EPA did not appear to be asking specific questions focused on that area. Members recommended that the fundamental research question under well injection should be divided into 2 questions: a) practices in well construction that are most protective of drinking water resources; and b) comprehensive well completion practices. Also, many of EPA's secondary research questions as presented in the study plan appear to be too broad and may raise expectations that may not be matched by EPA's products. The Panel recommended that EPA revise its 'secondary research questions' column and be more specific, or add a third column that might be titled 'specific research questions' that would identify actual questions that would be pursued, be narrowly defined, and would be accomplishable by the 2012 delivery date for the 2012 EPA report on HF research results. Regarding water acquisition, the Panel stated that the question is whether current regulations in place are insufficient to protect water resources. EPA should identify what has been learned about frequency of expected problems and what are the types of problems that have occurred in association with HF operations. In addition, the Panel recommended that EPA conduct research on how to respond to future HF problems, although recognizing that this may be outside of scope of study.

The Panel commented that it may not be possible for EPA to assess and study the relationship of HF pressure and fracture growth associated with well injection. The Panel suggested that EPA consider adding another specific research question on wastewater treatment and management related to recycling and reuse, develop trend information, and assess what are the impacts expected on water resources. Also, EPA should assess the connection between deep aquifers and natural surface flows.

The Panel discussed whether EPA should include discussion of BMPs on detection and response to HF problems, and felt it would be helpful to survey BMPs but try to identify actual, current HF practices. Also, EPA should try to gather and assess the significant HF data that industry has developed over the past 60 years to provide information on potential HF risk.

Charge Question 3: Research Approach

The Panel noted that the HF Study Plan presented inadequate detail and should present more specific research questions to allow EPA to address the overall research questions. The Panel recommended that the HF Study Plan indicate how case studies link to research questions, and state how models will be integrated among the various components. The Panel agreed that the Study Plan's scenario evaluation does not cross all research questions (particularly under water acquisition and flowback research) and thought such evaluation could help assess these issues beyond the case studies.

The Panel discussed how many case studies would be sufficient, and did not reach consensus on what would be a sufficient number. The Panel also discussed whether EPA should back off on prospective case studies and focus on retrospective studies, but did not fully resolve that question. The Panel indicated that the objectives for the retrospective and prospective case studies should be further developed. The Panel noted that given time and budget constraints prospective case studies would be difficult to conduct and assess. However, the Panel agreed that prospective studies will allow researchers to identify what data are needed, limitations of existing studies and data, and issues that retrospective studies cannot identify related to well drilling, flowback water, and other produced water. The Panel also suggested that it would be helpful to have date from retrospective studies when conducting prospective studies, but understood that available time may constrain such sequencing.

The Panel discussed trying to develop a statistically acceptable number of case studies but was not sure that would be helpful or meet the purpose of the case studies. The Panel generally agreed that providing some field data in addition to laboratory and modeling results would assist EPA's assessment.

The Panel recommended that field measurements for case studies be targeted, directed measurements and not based on a general monitoring plan. There were some suggestions by Panel members to gather microseismic data to support fracture modeling. Also, the Panel noted that since the Study Plan provided limited detail on how data analysis would occur, given time and budget constraints, EPA should use existing sampling and analytical methods and not develop new methods. The Panel also recommended that the Study Plan discuss data management in more detail, including sources, eligibility, storage, and archiving of data

Charge Question 4(a): Proposed Research Activities - Water Acquisition

The Panel noted that several research questions were too general as presented in the Study Plan, and recommended that EPA develop more specific research questions and assess research outcomes for water acquisition. A few members noted the need to link water quantity and quality research questions more tightly. The Panel recommended that EPA closely consider data needs to support water acquisition research before conducting such activities. The members also suggested that EPA conduct frequency and trend analysis, and noted that the U.S. Geologic Survey has a large amount of relevant surface water and groundwater data that could be assessed and graphed.

One member noted that HF constituents in water could have special impact on drinking water sources, and recommended that water acquisition research studies characterize source areas prior to HF activity (e.g., analyze for hydrogen sulfide, radon, methane, and bromides). The Panel recommended that EPA should reconsider the Study Plan's definition of a potable water source as 10,000 total dissolved solids or lower, since it may be too narrow.

The Panel also recommended that EPA add a specific research question regarding cumulative effects, and several members noted this question should consider potential impacts on forests, watersheds, headwater and downstream effects, waste disposal, and NPDES permits. In addition, members suggested that the role of timing and temporal variability should be considered more specifically, and assess transient vs. permanent effects and timing of withdrawals during different times of drought. Also, the panel discussed and recommended that water quality and quantity changes between watershed basins, and chemical species and water chemistry changes, should be considered. Such analysis could consider how a headwater

catchment area would affect downstream water quality.

The members requested that EPA consider variability in scenario development modeling, and noted that EPA's focus on average annual conditions should not be the only scenario considered. The Panel discussed potential ecosystem impacts on drinking water sources, and recommended that the broader view of cumulative ecosystem effects be assessed in later studies.

EPA responded that regarding water quantity and acquisition, there is a paucity of data across the country both spatially and temporally. EPA also noted that assessment of BMPs has not been emphasized in the study plan, since other agencies and entities are assessing this such as U.S. Department of Energy (DOE), the Groundwater Protection Council, and the Interstate Oil Commission. EPA does not want to replicate BMP research being done by others, but will do some examination of BMPs in the case studies.. EPA would separately research well construction and HF, and would plan to assess prospective case studies with industry partners as team members. Regarding literature sources, EPA responded that it recognizes the value and variable quality of different types of literature (peer reviewed, non peer reviewed, and grey literature), and noted that EPA's HF research is being conducted under EPA's highest quality assurance level (QA 1), and is being managed by a QA manager.

Tuesday March 8, 2011:

Charge Question 4(b): Proposed Research Activities - Chemical Mixing

The Panel noted that it is very important to gather information on what is the composition of HF fluids. The Panel suggested it would waste time to determine this from forensic analysis, and noted it strongly believes that industry would be well served to provide this information to EPA. A few members noted that some states were acquiring information on HF mixtures (Wyoming and Pennsylvania) and that such information may be useful to EPA.

The Panel recommended that EPA compile and refine a list of HF chemicals being used, and that EPA sort this list by geographic region and function of chemical, and then initially assess each chemical's known physical, chemical, and toxicological properties. The Panel agreed with EPA's plan to employ tracers, indicators or surrogates in the chemical mixtures used in the case study projects to assist in modeling efforts. The Panel recommended that EPA add a specific research question on the anticipated use and objectives for tracer data that would be gathered. A few Panel members recommended that EPA assess the frequency of HF chemical spillage and how states document this.

The Panel noted that EPA's anticipated toxicity evaluation and questions were much too broad, and that EPA should conduct a first order hazard assessment rather than detailed toxicological evaluation for each HF chemical being assessed. EPA should focus this assessment on HF chemicals with known toxicological effects, and perhaps use computational toxicology screening tools in this assessment. When categorizing HF chemicals based on potential toxicity, the Panel recommended that EPA consider EPA's contaminant candidate list as a guide for sorting chemicals.

Charge Question 4(c): Proposed Research Activities - Well Injection

The Panel recommended that EPA split wellbore integrity from well injection in assessing research questions. It suggested that EPA take advantage of existing research and data regarding

reservoir characterization and CO_2 flooding and storage. The Panel suggested there are three primary pathways for HF leakage to environment that EPA should assess: through the HF wellbore, HF fractures, or HF fracture intersections with fault systems. The Panel noted that EPA should consider how the depth of HF operations affect transmissivity of chemicals in the subsurface. The Panel also suggested that EPA consider how different formations may have greater potential for fracture.

The Panel noted that mass balance for all HF fluids was a key question that EPA should assess when developing the assessment framework, and suggested that such analysis would help assess HF leakage mechanisms. The Panel noted that EPA's case studies would provide opportunity to assess mass balance, particularly the prospective studies. The Panel suggested that EPA's planned assessment of well-failure frequency should list criteria that defines a failure. The Panel recommended that EPA improve its plan for collecting data on failure and include efforts to access existing information that likely exists on this topic. The Panel suggested that EPA gather such information from states and industries, and noted that such data will be in various forms and that EPA should determine how to aggregate this data.

The Panel recommended that EPA identify BMPs for well bore practices, including how to install and set casing and how to assess cement performance under HF conditions. The Panel noted that EPA should develop a good understanding of casing characteristics, lifetime expectancies, and failure rates. Several Panel members also suggested that EPA consider how industry locates abandoned wells from previous water resources development or oil/gas operations and take this into account when assessing potential impacts from HF operations.

The Panel noted that it is critically important to conduct detailed site characterization for case studies, and that the discussion in the draft study plan was limited on this topic. The Panel recommended that EPA consider doing fewer case studies with more site characterization. The Panel suggested that EPA consider conducting case studies at sites that are most likely to have releases of HF fluids. These sites may have shallow groundwater, or have natural fractures and faults. The Panel noted that if one or two of these sites was thoroughly characterized and evaluated, the most information could be gathered within the project's budget and time constraints.

Charge Question 4(d): Proposed Research Activities - Flowback and Produced Water

The Panel recommended that the Study Plan be revised to state whether the research focus is exclusively on shale gas units or whether the focus would be is to include coal bed methane and/or conventional natural gas. A number of recommendations were made regarding EPA's use of the risk assessment paradigm, and the Panel suggested that EPA describe at the beginning of the Study Plan how the paradigm would be used throughout the entire Plan. The Panel suggested that EPA focus on hazard identification and exposure, and expressed the view that the primary opportunity for human health exposure from HF operations is likely to be through HF waters on the surface. The Panel recommended that EPA's first order assessment for human health exposure should be on surface water management of HF waters. The Panel noted that a related effort would be determining which HF chemicals are of primary concern, and their probability for transport.

The Panel also agreed that EPA should distinguish flowback and produced water and what criteria would be associated with defining these waters. The panel noted that flowback and produced water are often difficult to distinguish, and recommended use of "post fracturing

produced water" to describe both early and later stage produced water. The Panel recommended that EPA should conduct an inventory of types of water being used in HF to answer questions regarding how much high quality water is being used (e.g., water less than 10000 TDS) vs. lower quality. Several members suggested that EPA review experiences from coal bed methane production in how to manage produced waters, and to identify scenarios for addressing produced water, hazards and spills. Other members suggested that EPA investigate Publicly Owned Treatment Works (POTWs) for data on HF flowback water. A member also suggested that EPA assess open and buried pits and leaky liner seals associated with HF operations.

Charge Question 4(e): Proposed Research Activities - Wastewater Treatment and Waste Disposal

The Panel discussed appropriate treatment alternatives for HF waters, and noted that EPA should assess the current state of practice for managing these waters. The Panel suggested that EPA conduct an objective analysis in different shale gas areas on how HF waters are being managed. The Panel noted there was a lot of knowledge available on treatment for many constituents in HF waters, and that any EPA work on this topic should leverage this knowledge and target any treatment research on unique challenges to HF flowback and produced waters.

The Panel noted there are several particular challenges with treating and disposing of HF waters, including: a) presence of constituents leading to disinfection by-products; b) radionuclide constituents; and c) organic constituents associated with HF operations. A few members noted that EPA should consider tracking chemicals associated with byproduct formulation. Several members recommended that EPA evaluate treatment costs and Environmental Justice issues at different HF lifecycle stages. The Panel suggested that EPA clarify pilot scale testing objectives, and also assess DOE's efforts with treating and disposing of HF waters and leverage efforts with DOE where feasible.

Several members also requested that EPA consider pretreatment requirements prior to disposal of HF waters in POTWs, and assess the fraction of HF wastewaters currently directed to POTWs. The members also suggested that EPA assess the critical limit for dilution flows in the POTWs. The Panel recommended that EPA clarify the role that Class II underground injection control wells play in addressing HF waters, and whether Class II wells would be assessed in EPA's study objectives.

Charge Question 5: Research Outcomes

The Panel discussed and made various suggestions for changing or reformatting EPA's presentation of research outcomes as noted in Chapter 6 of EPA's draft Study Plan. These suggestions were projected onto the viewing screen at the March 8, 2011 meeting, and are included on the Panel's March 8, 2011 meeting website.

Overarching Comments:

Dr. Dzombak invited the Panel members to offer any additional, overarching comments. Several Panel members suggested the following:

- EPA should expand the breadth of its analyses on existing data and summarize results of such analyses within its HF reports;
- To help focus retrospective studies, EPA should review stress maps for shale formations

at the sites;
- The Study Plan should address well construction, and add a horizontal well diagram;
- EPA should include a detailed description of the HF process within the Study Plan; and
- EPA should look for opportunities for cooperative efforts with industry in order to meet the goals for the HF study.

EPA staff thanked the Panel for its efforts at the meeting. EPA noted it would closely consider the key points it heard during the meeting. EPA staff also noted that its HF data collection and assessment efforts were bound by the Paperwork Reduction Act, and that it needs clearance from the U.S. Office of Management and Budget (OMB) for data collection from the public and industry. The EPA staff noted it will share data with the public as soon as such data can be shared. The staff noted it will be collaborating with universities, industry, other federal agencies, state agencies, and the public as it moves forward in conducting its HF research studies.

Dr. Dzombak discussed next steps and action items. With the meeting business concluded, the Designated Federal Officer Edward Hanlon adjourned the meeting at 4:30 pm ET.

Respectfully Submitted:

/signed/

Mr. Edward Hanlon
Designated Federal Officer

Certified as Accurate:

/signed/

Dr. David A. Dzombak
Chair
EPA SAB Staff Office Panel for the Review of Hydraulic Fracturing Study Plan

NOTE AND DISCLAIMER: The minutes of this public meeting reflect diverse ideas and suggestions offered by Panel members during the course of deliberations within the meeting. Such ideas, suggestions and deliberations do not necessarily reflect consensus advice from the Panel members. The reader is cautioned to not rely on the minutes to represent final, approved, consensus advice and recommendations offered to the Agency. Such advice and recommendations may be found in the final advisories, commentaries, letters or reports prepared and transmitted to the EPA Administrator following the public meetings.

Materials Cited

The following meeting materials are available on the SAB website: http://www.epa.gov/sab, at the March 7-8, 2011 SAB Hydraulic Fracturing Study Plan Review Panel Meeting page at http://yosemite.epa.gov/sab/sabproduct.nsf/a84bfee16cc358ad85256ccd006b0b4b/153ac7df8d2626f98525781000648075!OpenDocument&Date=2011-03-07 :

[1] Federal Register Notice Announcing the Meeting

[2] Agenda for March 30-31, 2011 Public Meeting

[3] List of Public Speakers

[4] Presentation from Dr. Kevin Teichman, Ms. Jeanne Briskin, and Dr. Robert Puls, USEPA

[5] Oral Statement from Susan Oliver

[6] Oral Statement from Cynthia Lane, American Water Works Association

[7] Oral Statement from Sarah Gingold, Food and Water Watch

[8] Oral Statement from Lauren Pagel, EARTHWORKS

[9] Oral Statement from Briana Mordick, Natural Resources Defense Council

[10] Oral Statement from Deborah Cowden, MD

ATTACHMENT A – ROSTER

U.S. Environmental Protection Agency
Science Advisory Board
Hydraulic Fracturing Study Plan Review Panel

CHAIR

Dr. David A. Dzombak, Walter J. Blenko Sr. Professor of Environmental Engineering, Department of Civil and Environmental Engineering, College of Engineering, Carnegie Mellon University, Pittsburgh, PA

MEMBERS

Dr. George Alexeeff, Deputy Director for Scientific Affairs, Office of Environmental Health Hazard Assessment, California Environmental Protection Agency, Oakland, CA

Dr Tom Ballestero, Professor, Civil Engineering, University of New Hampshire, Durham, NH

Dr. Mark Benjamin, Professor, Department of Civil and Environmental Engineering, University of Washington, Seattle, WA

Dr. Michel Boufadel, Professor of Environmental Engineering, Civil and Environmental Engineering, College of Engineering, Temple University, Philadelphia, PA

Dr. Elizabeth Boyer, Associate Professor, School of Forest Resources and Assistant Director, Pennsylvania State Institutes of Energy & the Environment, and Director, Pennsylvania Water Resources Research Center, Pennsylvania State University, University Park, PA

Mr. David Burnett, Directory of Technology, GPRI, Department of Petroleum Engineering, Look College of Engineering, Texas A&M University, College Station, TX

Dr. Thomas L. Davis, Professor, Department of Geophysics, Colorado School of Mines, Golden, CO

Dr. Shari Dunn-Norman, Professor, Geological Sciences and Engineering, Missouri University of Science and Technology, Rolla, MO

Dr. John P. Giesy, Professor and Canada Research Chair, Veterinary Biomedical Sciences and Toxicology Centre, University of Saskatchewan, Saskatoon, Saskatchewan, Canada

Dr. Jeffrey Griffiths, Associate Professor, Department of Public Health and Community Medicine, School of Medicine, Tufts University, Boston, MA

Dr. Phillip Gschwend, Professor, Civil and Environmental Engineering, Massachusetts Institute of Technology, Cambridge, MA

Dr. Cynthia M. Harris, Director and Professor, Institute of Public Health, Florida A&M University, Tallahassee, FL

Dr. Nancy K. Kim, Senior Executive, Health Research, Inc., Troy, NY

Dr. Cindy M. Lee, Professor, Department of Environmental Engineering and Earth Sciences, Clemson University, Anderson, SC

Dr. Duncan Patten, Research Professor, Hydroecology Research Program, Department of Land Resources and Environmental Sciences, Montana State University, Bozeman, MT

Dr. Stephen Randtke, Professor, Department of Civil, Environmental, and Architectural Engineering, University of Kansas, Lawrence, KS

Dr. Danny Reible, Professor, Department of Civil, Architectural and Environmental Engineering, University of Texas, Austin, TX

Dr. Connie Schreppel, Director of Water Quality, Mohawk Valley Water Authority, Utica, NY

Dr. Geoffery Thyne, Sr. Research Scientist, Enhanced Oil Recovery Institute, University of Wyoming, University of Wyoming, Laramie, WY

Dr. Jeanne VanBriesen, Professor, Civil and Environmental Engineering, Carnegie Mellon University, Pittsburgh, PA

Dr. Radisav Vidic, Professor and Chairman, Civil and Environmental Engineering, University of Pittsburgh, Pittsburgh, PA

SCIENCE ADVISORY BOARD STAFF

Mr. Edward Hanlon, Designated Federal Officer, U.S. Environmental Protection Agency, Washington, DC

ATTACHMENT B – Other Attendees

Public Meeting of the SAB Panel for the Review of Hydraulic Fracturing Study Plan

March 7, 2011

Name	Affiliation
Bagnell, Nicholle	Reed Smith
Barry, Kyndall	USEPA
Blank, Jennifer	No identified affiliation
Blank, Matt	No identified affiliation
Blank, Michael	No identified affiliation
Blank, Michael	No identified affiliation
Brushe, Shannon	Energy in Depth
Burden, Susan	USEPA
Clark, Corrie	Argonne
Constantine, Glena	USEPA
Cowden, Deborah MD	No identified affiliation
Debso, Notem	U.S. Department of Energy
Deeley, George	Shell
Degner, Dennis	Range Resources
Dip, David	USEPA
Drubin, Brian	Conoco Phillips
Dunlap, David	KCPS
Durst, Evian	USEPA
Farrell, Jesse	MI Swaco
Frances, Dick	Shell
Frenchkson, Katharine	Consol
Gillesar, Andy	USEPA
Gingold, Sarah	Food & Water Watch
Goodman, Iris	USEPA
Grannis, Jon	Marcellus Advise
Grumbles, Tom	Cordno Entrix
Gusky, Leigh	Akin Gump
Harlo, Chris	Argona
Hines, Ken	Wilmer Hale
Hruskoc, Irene	No identified affiliation
Hughes, Patrick	Height
Jackson, Tom	Baker Botts
Jennifer Hause	West Virginia University
Jewett, David G.	USEPA
Klieforth, Barbara	U.S. Senate
Lane, Cynthia	American Water Works Association
Luxton, Jane	Pepper Hamilton
McDonnell, Amy	Chesapeake Bay Foundation
Miller, Gregory L.	Engineer
Moldenhauer, Chip	Morgan Lewis
Mordick, Briana	Natural Resources Defense Council
Mukein, Memi	No identified affiliation

Name	Affiliation
Neodaus, Stephanie	American Petroleum Institute
Oliver, Susan	No identified affiliation
Pagle, Lavien	Earthworks
Pagliocca, Rachael	No identified affiliation
Parker, Michael	Exxon Mobil
Plotken, Victoria	American Gas Assoc
Power, Steve	Wall Street Journal
Puls, Bob	USEPA
Rankin, Richard	Idaho National Lab
Richards, Chelsea	Williams & Jensen
Seitz, Bart	Baker Botts
Shaw, Arden	Mckenna
Slagel, Gary	Marcellus Shale
Spain, Tia	WEA
Spencer, Jeff	Conoco Phillips
Teichman, Kevin	USEPA
VanVoorhees, Robert	Bryan Cabe LLP
Walsh, Bryan	Time
Winston, Kate	Inside EPA

Public Meeting, March 8, 2011

Name	Affiliation
Clevehart, William	No identified affiliation
Constantine, Gelena	USEPA
Gusky, Leigh	Akin Gump
Hause, Jennifer	West Virginia University
Kovski, Alan	BNA
Pag, Rachel	No identified affiliation
Qienor, Patrick	The Accord
Reinhault, T.P.	U.S. Department of Energy
VanVoorhees, Robert	Eco Reg Matters Ltd
Vlesson, Frank	Williams & Jensen
Welsh, Bryan	Time
Winston, Kate	Inside EPA